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R.K.M. Jayanty and Seymour Hochheiser

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16. ABSTRACT
A joint conference, for the fourth straight year cosponsored by the Air and Waste Management Association and the Atmospheric Research and Exposure Assessment Laboratory of the U.S. Environmental Protection Agency, was held at Raleigh, North Carolina, May 2-5, 1989. The technical program consisted of 145 presentations, held in 14 separate technical sessions, on recent advances in the measurement and monitoring of toxic and related pollutants found in ambient and source atmospheres. Covering a wide range of measurement topics and superbly supported by 57 exhibitors of instrumentation and consulting services, the symposium was enthusiastically received by more than 700 attendees from the United States and other countries. This overview contains a selection of the highlights from the technical presentations. A synopsis of the keynote address to the symposium is also included.

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Summary of the 1989 EPA/A&WMA International Symposium: Measurement of Toxic and Related Air Pollutants

R. K. M. Jayanty and Seymour Hochheiser
Technical Program Chairs

A joint conference, for the fourth straight year cosponsored by the Air & Waste Management Association's TP-6, TP-7, and ITF-2 technical committees, and the Atmospheric Research and Exposure Assessment Laboratory of the U. S. Environmental Protection Agency, was held at Raleigh, North Carolina, May 2–5, 1989. The technical program consisted of 145 presentations, held in 14 separate technical sessions, on recent advances in the measurement and monitoring of toxic and related pollutants found in ambient and source atmospheres. Covering a wide range of measurement topics and superbly supported by 57 exhibitors of instrumentation and consulting services, the symposium was enthusiastically received by more than 700 attendees from the United States and other countries. This overview contains a selection of the highlights from the technical presentations. A synopsis of the keynote address to the symposium is also included.

Measurement and monitoring research efforts are designed to anticipate potential environmental problems, to support regulatory actions by developing an in-depth understanding of the nature and processes that impact health and the ecology, to provide innovative means of monitoring compliance with regulations and to evaluate the effectiveness of health and environmental protection efforts through the monitoring of long-term trends. EPA's Atmospheric Research and Exposure Assessment Laboratory in Research Triangle Park, North Carolina, is responsible for research and development of new methods, techniques, and systems for detection, identification, and characterization of pollutants in emission sources and in indoor and ambient environments; implementation of a national quality assurance program for air pollution measurement systems; and supplying of technical support to agency regulatory programs.

This conference, which is the ninth in a series arranged each year by the EPA/RTP, and the fourth as a jointly sponsored conference by EPA and A&WMA, was arranged with the following primary objective: to provide a forum for the exchange of ideas on the recent advances for the acceptably reliable and accurate measurement and monitoring of toxic and related pollutants found in ambient and source atmospheres.

The growing number of responses each year to this symposium represents an encouraging first step to the enhancement of our current measurement and monitoring capabilities. As summarized herein, presentations include: 1) Measurement of Indoor Toxic Air Contaminants; 2) Measurement of Semivolatile and Volatile Organic Pollutants in Ambient Air; 3) Chemometrics and Environmental Data Analysis; 4) Acidic Deposition Studies; 5) Measurement of Hazardous Waste Emission; 6) Source Monitoring; 7) Exposure Assessment; 8) Measurement of TCDDs/TCDFs in Ambient Air; 9) Nicotine and Environmental Tobacco Smoke; 10) Superfund Site Air Monitoring; 11) Environmental Quality Assurance; and 12) General Papers Related to Particulate Measurements.

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Introductory Remarks and Keynote Address

G. Foley, EPA/RTP, followed by M. Rivers, A&WMA, welcomed the attendees to the symposium. M. Rivers then presented awards to R. Jayanty and S. Hochheiser for their service in arranging the symposium. In the keynote address to the conference, R. Hazel, Senior Official, EPA's Office of Research and Development at RTP, said that the laboratories at RTP will play a major role in environmental research to support agency priorities in the areas of the global climate change and stratospheric ozone, air toxics, ozone nonattainment, ecological and human exposure assessment. R. Hazel then discussed his past experiences in hazardous waste disposal problems (particularly a dioxin clean-up program in Missouri using a mobile incinerator) and the importance of the air toxic measurements at the hazardous waste sites.

Session I. Measurement of Volatile Organic Pollutants—Ambient Air

The first eight papers presented in Session I, Measurement of Volatile Organic Pollutants—Ambient Air, dealt with devices or modification of devices used to directly or indirectly sample for ambient air volatile organic compounds (VOC). The subject of these papers ranged from a preconcentration device used to facilitate on-site gas chromatographic (GC) analysis to an automated canister-based system which collects whole-air samples for subsequent laboratory analysis. Based on these first eight papers, there is a great deal of interest in further development of a compact, portable GC for field use, as well as continued interest in the use of canister-based sampling systems for routine ambient air VOC monitoring. The next three papers in the session presented data on the development of sampling networks for identification of particular VOC

sources. These proposed sampling networks had been tested in a variety of field situations which ranged from a complex, urban source configuration to a less complex, single rural source. The final paper in the session presented data on ambient air VOC concentrations from a water reclamation plant in the Chicago area.

The session on the measurement of volatile organic pollutants was continued on May 3, 1989. This session consisted of eight papers that described portable measurement systems and some of the laboratory work needed to support ambient air monitoring programs. The report by E. Overton and colleagues from the Louisiana State University presented the results of field measurements made using the portable microchip GC interfaced to an Ion Trap mass spectrometric detector described in an earlier talk. Grab samples and integrated charcoal adsorber measurements were taken in five industrial and two control sites, but did not show any unusually high concentrations or evidence of substantial emissions from the industrial sources. A paper in this session described a new mobile facility being developed by the Commonwealth of Massachusetts for emergency and special studies. Some of the problems involved in acquiring and outfitting such a facility were presented.

There were several papers dealing with the problem of defining detection limits in large scale monitoring programs. The detection limits for G/multidetector systems and GC/mass spectrometry and the comparability of the analytical results was the subject of the paper by J. Rice et al. of Radian Corporation. The determination of the total detection limits including both sampling and analysis using stainless steel canisters was the subject of the presentation by E. Winegar also of Radian Corporation. The use of surrogate or marker compounds and quantification standards to assess the performance of a GC/MS system and the development of a sample interface system to permit the introduction of such compounds in an analysis scheme was presented by D. Dayton.

The development of standards that can be used in quality assurance programs for measurement of volatile toxic organic compounds in the ppt to ppm range was outlined by G. C. Roderick of the National Institute of Standards and Technology. The session also included methods development papers by R. Jongleux on ambient aldehyde sampling and analysis methods in the NMOC and UATMP programs. An improved perchlorination procedure for the determination of total PCB levels in ambient air was presented by L. Ogle. In this new process, iron powder is used as a catalyst in an antimony pentachloride perchlorination process that is complete in ten minutes with greater than 80 percent yields. This procedure greatly reduces the time and cost of perchlorination compared to conventional methods.

Session II. Superfund Site Air Monitoring

Two of the papers in Session II described recent field experience in the monitoring of air toxics at Superfund sites. One of these papers, presented by J. Hudson of the U. S. EPA Region VII Office, described an effort to monitor toxic air emissions in the vicinity of a Superfund air stripper/vapor extraction facility. J. Hudson's paper was noteworthy for the success of his project and for the high quality of QA/QC information presented. A second air monitoring paper, presented by C. Wisner of Colorado State University, described an innovative and successful approach for characterizing fugitive emission rates using a mobile integrating sampler. The above field monitoring papers were complemented with the presentation of two papers dealing with more theoretical aspects of Superfund site air monitoring. C. Schmidt of Radian Corporation presented a discussion on the development of a Manual on air pathway analysis and the estimation of emission rates at hazardous waste sites. The Manual is intended to provide guidance to EPA Regional and contractor personnel in the design and implementation of Superfund site air monitoring activities. A second theoretical paper, presented by C. Allen of Research Triangle Institute, provided a very interesting description of the theoretical aspects of air emission prediction and measurement techniques for Superfund site applications.

J. Wyman of Booz, Allen, and Hamilton presented a paper on the use and control of air strippers. This paper included current information on the number of air strippers in use throughout the United States and on the use of emission controls at these units. J. Ronan, III, of Sedgwick, Detert, Moran, and Arnold provided a thorough discussion on the topic of Superfund remedy selection under the new EPA National Contingency Plan. Finally, Y. Crume of Engineering Science presented a paper describing the need for personal protection during Superfund site investigations. Included in Y. Crume's discussion was an explanation of the circumstances under which inhalation protection is appropriate during on-site activities.

Session III. Acid Deposition

Acid deposition sessions were conducted on Tuesday, May 2, and Wednesday, May 3. Papers presented during the Tuesday session addressed field observations of ozone and acidic deposition. E. Edgerton presented rural ozone data for the summer of 1988, collected as part of the National Dry Deposition network. Results showed that elevated ozone levels were associated with stagnant high pressure systems and that the majority of concentration values $\geq$ 100 ppb were associated with four stagnation episodes. V. Saxena described acid deposition measurements at Mount Mitchell, with emphasis on the importance of cloud capture mechanisms. Results showed that, during the growing season, Mount Mitchell is enshrouded in clouds roughly one-third of the time and that deposition of acidic species was dominated by cloud water, followed by wet deposition, then dry deposition. In a companion paper, T. DeFelise explored frequency distributions of cloud water deposition episodes at Mount Mitchell. Extreme deposition episodes (pH $<$ 3.1) were found to comprise roughly 25 percent of all events. It was suggested that these somewhat infrequent episodes play a major role in the acidity and nutrient budgets of high elevation forests. In the final paper for the day, A. Williams described a hypothesis for road dust enhancement of SO_2 dry deposition. Although most road dust settles quickly near the source, it was suggested that significant amounts undergo atmospheric transport and are ultimately deposited on plant surfaces. The road dust contaminated plant surfaces, in turn, behave as better sinks for atmospheric SO_2 than uncontaminated plant surfaces.

Papers presented during the Wednesday session addressed new methods for measurements of acids and acid precursors in precipitation and the ambient atmosphere. J. Slater presented data from investigations on strong acidity losses due to practical interactions on filter media. In general, results showed that significant amounts of acidity could be lost from filters as a result of acid-base type reactions. It was suggested that correction factors may need to be applied to aerosol acidity data to account for such reactions. Annular denuders coupled with multi-stage filter pads could provide data necessary to make corrections. S. Randtke discussed precision studies on an annular denuders/filter pack system and limitations on atmospheric sampling. Although typical precisions for sulfate, sulfur dioxide and nitric acid were on the order of 2–5

percent, it was nevertheless extremely difficult to resolve atmospheric gradients above the constant flux layer. It was recommended that measurements within the constant flux layer be coupled with transport theory to determine dry deposition rates. In the last paper for the session, C. Lin described the development of a collection and analysis technique for S(IV) in atmospheric precipitation. Results showed that S(IV) could be collected, with good reproducibility and stability, in a modified wet/dry deposition sampler. Initial field tests at a number of sites in the northeastern United States showed that S(IV) concentrations were nondetectable in approximately half the roughly 200 samples collected.

Session IV. Source Monitoring

The session consisted of twelve papers, eight of which described source sampling methods development or validation. The other four described source related analysis procedures research or planning and interpretation of source evaluation projects. W. DeWees of Entropy Environmentalists described research which evaluated determination of condensible matter from stationary sources by recovery and quantitation of the EPA Method 5 impinger catch. J. Fulcher of Research Triangle Institute presented data documenting development and validation of a source test method for acrylonitrile emissions. The method is simple to implement, has a demonstrated accuracy, and appears to be unaffected by moisture and acrylonitrile levels. S. Steinberger of Entropy Environmentalists reported on laboratory evaluation of a gas chromatography electron capture detector method for HCl gas cylinder analysis. W. DeWees of Entropy Environmentalists presented results of a laboratory and field evaluation of a sampling and analysis method capable of simultaneously determining HCl and Cl_2. T. Ward of U. S. EPA, AREAL reported on laboratory and field evaluation of a method for measuring emission of multiple metals from stationary sources. S. Steinberger of Entropy Environmentalists presented sampling and analysis methodology for measurement of low levels of hexavalent chromium from stationary sources. The new sample train design recirculates stabilizing solution between the impinger and the sampling nozzle. D. Holzshuh of U. S. EPA, OAQPS presented proficiency test data interpretation and high elevation data comparison for woodstove emission certification testing. M. Toney, U. S. EPA, OAQPS discussed modifications to a noncatalytic wood heater for proficiency testing. J. Goodrich of Entropy Environmentalists reported on field evaluation of butadiene sampling using small volume containers at a rubber plant. A. Carver of Entropy Environmentalists reported on a field evaluation of a measurement method for emissions of chlorinated solvents from high temperature and high moisture stationary sources. A bag sampling procedure and a sorbent procedure were tested for collection of perchloroethylene, trichloroethylene, chloroform, and carbon tetrachloride. C. Schmidt of Radian Corporation presented a technical approach for conducting an air emissions assessment at a large facility with multiple point sources. Finally, L. Edwards of Radian Corporation reported on measurement of emissions from a medical school facility.

Session V. Measurement of Hazardous Waste Emissions

Session V of the conference, entitled "Measurement of Hazardous Waste Emissions," included eight papers with topics ranging from measurement of volatilization of organics from waste to ranking of hazardous wastes sites. The first paper, which was presented by R. Dupont of Utah State University described a method for the determination of volatilization corrected degradation rates of hazardous materials in soils. Laboratory flasks or column microcosms were used to simulate the upper air-soil boundary. Zero air passed through the flask/column was used to collect headspace emissions and the mass of compounds remaining were determined to obtain a mass balance. J. Knoll of the U. S. Environmental Protection Agency described the field evaluation of a flux chamber for measuring volatile organic emissions from hazardous waste surface impoundments. The study, which was performed at an open storage tank at one site and on a surface impoundment and an overflow basin at a second site, showed the coefficient of variation of the method ranged from 3.5 to 19 percent for stable compounds, with most of this variability due to sample collection and storage. Two approaches to on-line measurement for the purge and trap apparatus used to determine volatile organics in hazardous waste were presented by A. Gholson of Research Triangle Institute. One was oxidation of the volatiles to CO_2, reduction of the CO_2 to CH_4, and measurement by FID; the other was direct measurement by FID. This latter procedure showed the better recovery and was more efficient overall. T. Minnich of NUS Corporation described the integration of long path fourier-transform infrared, long path ultraviolet and differential absorption lidar (DIAL) as a means for real-time analysis of toxic air emissions. The results of these measurement combined with complete on-site meterological assessments are especially valuable to meeting Superfund's hazardous waste data quality objectives and Hazard Ranking System scoring. G. Rojeck, also of NUS Corporation, described a case study using remote sensing. Concerns in this effort included site history, selection of lines of sight needed for the remote spectroscopic measurements, and selection of meteorological sites. Using remote sensing, path integrated averages for toluene of 20–23 ppm were found. Identification of complex principal organic hazardous constituents and products of incomplete combustion were the topic of a paper presented by R. Adams of Southern Research Institute. He described mass spectrometric techniques for identification of less-volatile target components or unknown compounds found in hazardous waste incinerator emissions. M. Peterson of Research Triangle Institute described a method to estimate the amount of hydrogen chloride that will form during incineration of a waste. This tube furnace technique showed organochlorine compounds to be essentially completely converted to HCl. An especially interesting and important observation was that NaCl in the presence of a source of hydrogen is also converted to HCl. Finally, T. Wolfinger of the MITRE Corporation described his efforts with development of "potential-to-release" criteria which are to be included in the Hazard Ranking System. Parameters of concern include types of sources present, mobility of the contaminants, and the containment of the sources.

In summary, some eight papers were presented. The principal topic of concern was the characterization of volatile organic and inorganic chemical emissions from hazardous wastes.

Session VI. Exposure Assessment

The afternoon session included two papers on NO_2 personal monitors. Joseph Stetter of Transducer Research described a prototype real-time electrochemically-based monitor capable of achieving ppb sensitivity. D. Moschandreas of IIT Research Institute presented recent work on a passive sampler for NO_2. M. Brauer of the Harvard School of Public Health reported on results from a study employing personal monitors with denuders for determining exposure to acid aerosols. T. Kelly of Batelle Columbus described attempts to adapt atmospheric pressure ionization mass spectrometry to analyze human breath on a near-continuous basis.

Eight papers were presented in the morning session. L. Wallace of EPA gave an overview of the two large scale studies of population exposure to toxic organic vapors under the Total Exposure Assessment Methodology (TEAM) Program in 1987. The next two papers were presented by W. Nelson, EPA, and K. Thomas of RTI on the New Jersey TEAM VOC Study. T. Hartwell, RTI presented the statistical analysis results of the 1987 TEAM study conducted in California. R. Wiener, EPA, gave an overview of the planning and accomplishment during the last four years on the particle TEAM (P-TEAM) studies. J. Spengler, Harvard School of Public Health described the analytical procedures for mass, elemental and chemical analysis personal exposure to particulate matter. L. Sheldson of RTI presented study design as well as sampling and analysis methods for the PTEAM prepilot study. Finally, R. Anderson, University of North Carolina discussed the results of a co-location study of PM_{10} and PM_{25} in inertial impactors for the assessment of indoor air aerosols.

Session VII. Measurement of Chlorinated Dioxins and Chlorinated Dibenzofurans in the Atmosphere

Seven papers were presented in this session. G. Hunt of ENSR Consulting and Engineering described the critical factors in sampling net work design for monitoring of ambient chlorinated dioxins and chlorinated dibenzofurans (PCDDs/PCDFs) in the vicinity of municipal solid waste incinerators. Y. Tondeur et al. presented a modification to the Method 8290 in the form of flow charts and supporting data for the determination of picogram quantities of PCDDs/PCDFs in either ambient air or stack emission samples. B. Eitzer et al. of Indiana University showed the data collected for PCDDs/PCDFs in the ambient atmosphere of Bloomington, Indiana. The total concentration of dioxins and furans varied by a factor of 10 but generally they were between 1 and 4 pg/m^3. B. Maisel of ENSR presented on the role of QA/QC in the interpretation of ambient PCDDs/PCDFs data, followed by T. Logan of EPA/RTP on the development and implementation of dioxin/furan performance audit program. Finally, two papers were presented by C. Rappe of the University of Omea, Sweden on the Correlation of PCDDs/PCDFs in ambient air to those found in combustion source emissions. A comparison of various sampling methods at a Swedish municipal solid waste incinerator for the collection of PCDDs/PCDFs is described.

Session VIII. Nicotine in Environmental Tobacco Smoke

This session consisted of 11 presentations on research related to the determination of exposure to nicotine and use of nicotine measurements to estimate exposure to environmental tobacco smoke in indoor environments. The first paper, presented by F. Caka of Brigham Young University, gave the results of an intercomparison study on the measurement of nicotine conducted by six different laboratories. The study compared results obtained using filter pack, diffusion denuder, sorbent bed and passive sampling devices to determine gas phase, particulate phase and total nicotine in environmental tobacco smoke generated in an experimental chamber. Agreement among the various techniques was good with the notable exception of a passive sampler for which the sampler removed nicotine before it could reach the absorption surface. The next four papers present reports on new techniques for the determination of nicotine. P. Koutrakis of the Harvard School of Public health, gave details on the design and evaluation of a personal annular denuder sampler to measure both gas and particulate phase nicotine in environmental tobacco smoke. M. Ogden, of Reynolds Tobacco Company, gave data on the evaluation of a personal passive sampling device for determining exposure to nicotine and described techniques they have used to minimize artifacts in the use of the sampler. The use of ion trap mass spectrometry for the determination of nicotine in the environment on a real-time basis was described by M. Wise of Oak Ridge National Laboratory. D. Eatough, Brigham Young University, described the development of a briefcase-size sampling system for the determination of several constituents of environmental tobacco smoke. The sampler is designed to be used to determine air quality in commercial aircraft cabins and includes an annular denuder to determine nicotine and a multipoint Tenax® sampling system for the determination of the variations in nicotine concentrations during the sampling period.

The next three papers presented the results of surveys of nicotine in indoor environments. G. Oldaker III, Reynolds Tobacco Company, presented results using a multiport sampling system using XAD-4 resin sorbent to determine the time course of nicotine concentrations in a tavern and to determine the effects of operation of the ventilation system on the observed concentrations. A survey of concentrations of nicotine in supermarkets normally encountered during shopping, using an XAD-4 based personal sampler, were presented by M. Ireland of Lorillard. K. Hammond, University of Massachusetts, presented data on the concentrations of environmental tobacco smoke present in homes of smokers determined using both filter pack sampling systems and passive samplers placed in various locations in the homes and worn by nonsmoking children in the homes.

The last three papers of the session gave the results of various special studies on environmental tobacco smoke. H. Tang, Brigham Young University, described the determination of the relative rates of generation and decay of environmental tobacco smoke constituents in an experimental trailer as sequential cigarettes were burned. The data indicated that nicotine was rapidly removed from the environment and that NO was converted to other nitrogen oxides. Results of a multilaboratory study to assess the exposure of pre-school children to environmental tobacco smoke for homes with and without smoking were presented by J. Mumford of EPA and by F. Henderson of the University of North Carolina. J. Mumford described the techniques used to determine exposure of the children to PM_{10}, nicotine and particulate mutagens. Dr. Henderson discussed the relationship between home air nicotine concentration and the concentrations of cotinine in the urine of the exposed children, comparing the results of recent studies with those of previously reported studies.

Session IX. Measurement of Semivolatile Organic Pollutants in Air

Papers in this session dealt with the collection and analysis of high molecular weight organic compounds in ambient air. The glass fiber filter-polyurethane foam (GFF/PUF) system, used for high-volume sampling of many non-polar compounds, was examined in two studies. H. Kimball tested EPA Compendium Method T04 for collecting PCBs from ambient air. When air was drawn through PUF plugs which were fortified with individual PCBs, extensive losses of the lower homologs occurred, apparently caused by analyte breakthrough. W. Cotham described a laboratory apparatus to study the adsorption of pesticide vapors to a GFF loaded with urban air particulate matter. PUF plugs behind the GFF were used to monitor gaseous analytes, allowing apparent gas/particle partition coefficients to be determined. Using samples collected on a GFF/XAD-2 train in the Integrated Air Cancer Project, J. Childers showed how GC coupled with matrix isolation-Fourier transform infrared spectroscopy can be used to discriminate isometric PAHs

and xylenes in air samples from a wood smoke impacted area.

The growing interest in oxygenated organic compounds was demonstrated by the themes of several papers in this session. L. McConnell described the use of a PUF-Tenax "sandwich" cartridge for collection of chlorinated phenols from ambient air. In laboratory trails, 82–103 percent of di-through tetrachlorophenol and 66 percent of pentachlorophenol spikes were recovered from 250–350 cubic meters of air. S. Hawthorne used low- and high-volume systems consisting of a quartz fiber filter backed up by a PUF trap to collect methoxylated phenolic tracers of wood smoke from individual chimneys and ambient air. Use of PUF sheets in the high volume sampler (instead of conventional PUF plugs) allowed quantitative collection of methoxyphenolic compounds while maintaining the 40 cfm airflow required for the 10-micrometer particle cutoff. In another paper, Hawthorne described the use of super critical fluid (SFE) extraction and coupled SFE-GC to greatly shorten sample processing and analytical times over those required by conventional techniques. E. Atlas reported finding alkyl nitrates, aldehydes, and oxygenated PAHs over the mid-Pacific Ocean. The alkyl nitrates, formed by photochemical oxidation of alkanes in the presence of nitrogen oxides, appeared to be of continental origin. The aldehydes showed a strong odd carbon preference, suggesting that they are produced directly by organisms or by photochemical oxidation of other biogenic precursors. Y. Tang described a novel multi-functional GC detector capable of being operated in an ionization or photometric mode. Choice of conditions allowed selective detection of halogenated compounds (in an electron capture mode) and oxygenated PAHs (in photometric or electron capture modes).

Session X. General

Several papers were presented in three separate general sessions. J. Serne of Roy F. Weston, Inc., presented the first paper with information on an ambient air monitoring program near a municipal solid waste resource recovery facility in Detroit. The program documented levels of ambient pollutants at two locations. One location was near the recovery facility and was so sited to expect maximum ground level pollutant concentrations. The second site further away near a playground was selected as representative of the regional urban background air quality. Ambient pollutant data from these sites were shown. B. Betz of Supelco, Inc., presented results of ongoing research to classify carbon molecular sieve adsorbents for use in sampling of volatile contaminants in the work-place and ambient atmosphere. The control of physical and chemical characteristics of the carbon molecular sieves in manufacture results in specific properties which can be taken advantage of for various pollutant sampling applications. C. Schmidt of Radian Corporation, described the development of a technical approach to a program of sampling, analysis, and data usage for assessing the environmental impacts via the air pathways from contaminated groundwater. Results were presented of a study near the fence line and nearby areas to a manufacturing facility. R. McAllister of Radian Corporation, discussed the cleanup of stainless steel canisters used for ambient air collection and showed results of a ninety site field study for monitoring non-methane organic compounds. Field samples returned to the laboratory were analyzed by cryo-condensing and flame ionization detection. N. Reid of the Ontario Ministry of the Environment described the systems used in a sampling network to monitor trace metals in air and precipitation. Data from this network of monitors in use since 1980 was shown from which spatial patterns of deposition were established along with the importance of deposition to the Great Lakes. A. Linenberg of Sentex Sensing Technology Inc., described the calibration and use of purge and trap techniques of a unique instrument to determine organic volatiles in ground water. Using a portable gas chromatograph for the analysis of volatile organics, quick determinations of water samples could be accomplished with proper selection of standards. R. Arnts of EPA evaluated the effect of ozone on the analysis of low level concentrations of formaldehyde in air using the acidified 2,4-dinitrophenylhydrazine/silica gel cartridge technique. Results presented showed high losses of formaldehyde when 120–700 ppb of ozone was co-sampled with formaldehyde using the cartridges. The liquid impinger technique did not exhibit a reduction of formaldehyde values when co-sampled with ozone. M. Singh of the Indian Institute of Technology in New Delhi showed cases of large chemical spills in India which severely affected many people. He discussed the meteorological and chemical conditions conducive for the accumulation of pollutants. S. Randtke of the University of Kansas discussed the use of greased and oiled impactors for the collection of ambient aerosol samples. Particles collected on greased surfaces when exposed to acidic or basic gases in air reacted to a small extent. Oil trapped particles did not exhibit such reaction when exposed to these gases. Results indicate coarse particles can be collected without significant artifact formation with oiled impactors. A. Gaskill, Jr., of Environmental Reference Materials presented results of recently developed test kits used to determine the concentration range of chlorine in waste oils. These kits can provide rapid screening of waste oils for chlorine content. J. Kertzman of Perma Pure Products described the new braided version of Nafion tube dryers. Examples of analytical techniques were reported using the tube dryers. B. DasSarma of West Virginia State College showed results of routine monitoring of organic compounds in outdoors and indoor air at the College which is close to chemical complex operations. These measurements were compared with modeled concentrations in the Kanawha Valley toxics screening study. M. Agrawal of the Banaras Hindu University of India showed the effects of vegetation damage in an area near an aluminum factory. She discussed the effect of aluminum uptake by the plants through the stomata and what effects this factory had on the local vegetation. R. McAllister of Radian Corporation described the system using stainless steel canisters and their cleanup for use in making low level organic compound calibration standards. R. Harrell of NSI Technology Service, Inc., presented the last paper of the session in which she discussed the clean up procedures of stainless steel canisters and the preparation and certification procedures for selected organic compounds. On Friday, in the continued General Session, B. Gay, U.S. EPA, discussed photolysis experiments of chlorine which produced radicals by extracting a hydrogen atom from or addition to a double or triple bond of a reactive compound. Ozone was one unanticipated product from this photolysis with acetylene. However, no ozone was formed under the same conditions with methyl and ethyl acetylenes. The ozone product may be related to the size of the radical formed from a reaction of chlorine radicals with acetylene.

D. Barraclough, National Institute of Standards and Technology, described a procedure for determining the total carbon concentrations of atmospheric aerosols using a Leco CS-244 carbon-sulfur analyzer. The method was applied to suspended particulate matter collected during the Boise, Idaho Integrated Air Cancer Project. Regression analysis of external calibration curves indicated a linear relationship in the range of 20 to 250 μg carbon.

J. McGee, NSI Technology Services, presented design, construction, and operation information for a multiple sample point, automated temperature and relative humidity monitoring system. The system is used to monitor these variables in three inhalation exposure laboratories. The measurement and computational principals are general and may be extended to other temperature/humidity monitoring applications. R. Segall, Entropy Environmentalists, Inc., presented a screening method for hexavalent chromium emissions from stationary sources including chromium plating facilities, and comfort and industrial cooling towers. The method is field portable and allows the assessment of emission levels at substantially reduced sampling and analytical time, and overall cost compared with the reference test method. R. Merrill, Radian Corporation, described an approach to accurate, cost effective analyses of whole air samples collected during remedial action at waste sites. Detailed speciation of every sample collected using gas chromatographic/mass spectrometric (GC/MS) methods is not required during waste site remedial action. This simplified method uses a Preconcentration Direct Flame Ionization Detection method for screening nonmethane hydrocarbon (NMOC) concentrations. Only those samples having a NMOC concentration exceeding a trigger limit are speciated by GC/MS. The overall analysis cost is reduced by 30 percent. N. Reid, Ontario Ministry of the Environment, discussed the Ontario Ministry's toxics deposition network for collection and determination of the concentrations of chlorinated species in the Great Lakes Basin. Twenty-eight day precipitation samples are collected, using a wet-only collector. Modified high volume samplers are also used to obtain four-day air samples. The organic content of both air and rainwater samples are trapped in XAD-2 cartridges. Analyses were conducted for pesticides, PCBs, PAH, dioxins, and furans. M. Barboza, Malcom Pirnie, Inc., traced the air sampling steps taken from the early 1970s to the present. The driving forces included regulatory requirements and improvements in analytical techniques. The magnitude of the air sampling problems has grown from initial concern over criteria pollutants to the present additional concern for several hundred air toxic compounds at relatively lower concentration levels. The use of newer approaches and emerging technologies such as long path infrared and ultraviolet absorption were discussed.

K. Starner, Research Triangle Institute, described the development of test audit materials to simulate airborne asbestos dust samples obtained during asbestos removal from buildings. Sets of test membrane filters were prepared from a suspension of chrysotile fibers and a matrix of urban dust (NBS SRM 1648) suspended in Freon. Portions of the test filters were distributed to external laboratories to evaluate the preparation technique and determine the suitability of the samples for use as audit materials. Generally, the external laboratories reported lower than anticipated fiber counts. Work is continuing to improve the inter-laboratory fiber counting reproducibility.

Session XI. Measurement of Indoor Toxic Air Contaminants

This session included seven technical papers. M. Berry of the U. S. EPA Environmental Criteria and Assessment Office summarized the indoor air pollutants and mixtures of concern from the health risk viewpoint. D. Naugle of the Research Triangle Institute then illustrated the use of a new Risk Characterization Framework using benzene data from an EPA TEAM study. This technique explicity shows all computations and key assumptions in arriving at health risk estimates.

The seasonal composition of fine aerosols found indoors and outdoors at 40 homes each in Steubenville, Ohio and Portage, Wisconsin was presented by S. Santanam of Harvard University. Results show that indoor sulfate levels were significantly higher during summer months than in winter, likely caused by outdoor sulfates. D. Moschandreas of the IIT Research Institute described the performance of NO_2 Personal Sampling Devices (PSDs) under extreme temperatures between −10°F and +105°F. Both accuracy and precision are affected at these extremes, apparently due to the combined impact of temperature and relative humidity. Use of a fluorescent tracer of pesticide dermal exposure with video imaging was explored by R. Fenske of Rutgers University. Children's exposure from pesticides used inside residences and on lawns was studied.

R. Anderson of the Solar Energy Research Institute presented data from an instrumented test facility. He depicted the ability of ventilation systems to eliminate nonuniformities which can produce unacceptably high localized concentrations. Basement soil gas sampling techniques and tests were described by P. Piersol of ORTECH International, Ontario, Canada. Passive sampling bags were inflated satisfactorily for entry points such as floor drains, sump pits, and wall tubes in determining the rate of entry of soil gas.

Session XII. Chemometrics and Environmental Data Analysis

In the chemometrics and data analysis session there were a total of seven presentations. The contents of the presentations ranged from the acquisition and treatment of chromatographic, mass spectral and infrared data analytic methods for exploratory and in-depth interpretation of the data. Dr. Smit of the University of Amsterdam and one of the developers of correlation and chemical modulation techniques in chromatography discussed the more practical aspects of this method as well as some of its disadvantages. Correlation chromatography is elegantly simple and optimal for the analysis of extremely low levels of substances, and should be useful in the monitoring of components of ambient air where low levels of contaminants are the rule rather than the exception. Dunn and his coworkers at the University of Illinois at Chicago have developed pattern recognition methods for application to GC/MS data obtained from ambient air samples. This technique offers a number of advantages to library searching methods resident on commercial instruments. One of the most useful and high quality MS data bases is the NBS/EPA/MSDC mass spectral data base which is available for installation on personal computers. D. Scott discussed the statistical distribution of ions in the data base and reported on his work in determining the Shannon information content of the various ions in the data base. Such data are necessary if the statistical significance of data interpretation results is to be evaluated. The use of three-mode factor analysis was discussed by P. Hopke of the University of Illinois. P. Hopke reported on the application of this variant of factor analysis to the interpretation of airborne particulate data.

W. Riggin discussed software he has developed for the display of cancer epidemiological data. A data base of concentrations and occurrence of volatile organic compounds in ambient air was discussed by J. Shah. The data base, available through G_2 Environmental, Inc., is personal computer compatible and uses standard data base programs. A major problem with waste site assessment is obtaining an on-site evaluation of the compounds present. The use of Fourier-transformed infrared spectroscopy for on-site monitoring was discussed by S. Levine of the University of Michigan. Actual cases in which the use of infrared was used in waste site assessment were presented.

Session XIV. Environmental Quality Assurance

For this session, a variety of quality assurance topics were addressed in seven presentations. The first two papers pertained to planning experiments. They were given as a skit with M. Messner and A. Clayton of RTI acting as a scientist and statistician, respectively. At the end, the statistician presented a preliminary design and power analysis results for an experiment to investigate particulate emissions from different types of woodstoves. C. Riley's talk was titled "Secrets of an External Quality Assurance Auditor." He discussed QA for a project where the Environmental Protection Agency is gathering dioxin, trace metals, HCl, and particulate emissions data from municipal waste combustors. The fourth presentation given by R. Rhodes of EPA was on "Quality Assurance for the Integrated Air Cancer Project Study at Roanoke, Virginia." The QA program, certain external audit results, and quality control results were discussed.

G. Johnson of EPA's Quality Assurance Management Staff discussed the benefits of applying Management Systems Reviews (MSRs) to air toxics and hazardous waste measurement programs and included several case studies. Quality Assurance in the Staten Island/Northern New Jersey Urban Air Toxics Assessment Project was the topic of A. Teitz's presentation. This EPA Region II project requires extraordinary quality assurance measures because four different organizations collect samples, six laboratories analyze samples, and seven sampling methods are used. B. Oslund of the California Air Resources Board filled in for R. Effa to discuss a procedure for measuring total system error in ambient organics toxics monitoring. This study assessed the feasibility of using dilution to generate an accurate ambient level toxics audit sample that could be introduced into the toxics sampling train.

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R.K.M. Jayanty is Manager, Environmental Methods and Standards Department, Research Triangle Institute, P.O. Box 12194, Research Triangle Park, NC 27709; Seymour Hochheiser is Program Operations Director, Atmospheric Research and Exposure Assessment Laboratory, U. S. Environmental Protection Agency, Research Triangle Park, NC 27711.